REMARKS/ARGUMENTS

Continued Examination under 37 C.F.R. 1.114

The Examiner's acknowledgement of the Request for Continued Examination is noted. It is further noted that the finality of the previous Office Action has been withdrawn.

Claim Amendments

Claim amendments are detailed above in the standard formant. Generally, all the independent claims require a "fuel cell peripheral" comprising at least one of a "coolant recirculation pump" and a "hydrogen purging device". In claims 1 and 6, reference is now made to a "hydrogen purging device" rather than a "hydrogen purging means", this being consistent with usage elsewhere in the specification. Reference to "hydrogen recirculation pump" is being deleted.

Election/Restriction

The Examiner has acknowledged that claims 11-16 could be properly rejoined to claims 1-10 for examination but at the same time maintains that claims 17-20 are still directed to an invention that is independent or distinct.

In response, claim 17 is being amended to introduce the feature of the fuel cell peripheral comprising "at least one of a coolant recirculation pump and a hydrogen purging device".

The Examiner had previously argued that claim 17-20 represent a "different mutual exclusive embodiment of such a fuel cell system and it's operating method", since these claims include details of a recirculation loop that is not mentioned in the other claims.

It is submitted that, in view of this amendment, claims 17-20 can properly be examined together with the existing claims 1-16. By virtue of the amendment now being entered to claim 17, claim 17 is of no broader scope than the first set of claims 1-16. The simple recitation of the recirculation loop is merely the addition of a further feature that, if anything, serves to restrict the scope of the invention claimed.

Claim Rejections 35 U.S.C. 102

Claims 1-2, 4, 6-7, 9 and 11-16 stand rejected under 35 U.S.C. 102(a) as being anticipated by 2005-0008905. With respect to claims 1, 6 and 11 and 15-16, the Examiner noted that: "Of particular interest is that Blum et al. employ a relationship between the current demand and the fuel mass flow as a function of time to control and operate the fuel cell system. *Thus, Blum et al. specifically use a measured fuel cell operation characteristic to control another respective operation characteristic*". The Examiner referred to Figure 3 and reproduced Figure 3 in the Action. All Figure 3 of Blum et al. shows is that, in response to an increase in a desired target current, the supply of fuel and supply of hydrogen are increased. In any fuel cell system, over the long term, the supply of fuel or hydrogen must correspond with the power output. There may be short-term transients that are, one way or another, buffered. For example, where recirculation is provided, the concentration of a reactant in a concentrated circulation loop may vary slightly where supply of fuel to the circulation loop does not precisely track changing power output of the cell.

However a key characteristic in all these systems is that supply of fuel is not a "peripheral". Rather, supply of fuel is fundamental to the operation of the fuel cell and necessarily must be supplied in proportion to the power output. Thus, over the long term, supply of fuel must track power output, at least if the fuel is to be used efficiently. For this reason, many fuel cell systems will provide for some sort of proportional control of the fuel input in dependence upon the power output. The key feature here is that this requires careful monitoring of the power output and controlling the fuel supply so that it closely follows the power demand or output. In general, there needs to be some linear or continuous correspondence between the variation in power output and fuel supply.

In contrast, the present invention is concerned with operation of peripheral devices, whose operation would not directly impact operation of the fuel cell. Thus, as recited in claim 1, the peripheral is selected from one of a "coolant recirculation pump" and a "hydrogen purging device". A key realization of the present invention is that operation of such devices does not need to be driven by some complex control scheme based on precise and exact proportionality relative to, for example, power output.

Rather, it has been realized that, for these peripheral devices, it is quite adequate in most cases, if they are operated at a number of discrete levels or operation characteristics, each corresponding to the range within the fuel cell operation characteristic spectrum. For example, when a fuel cell is idle or operating at a low level, it is wasteful to have a coolant pump running at its maximum level and similarly it is wasteful to have a hydrogen purging cycle actuated too frequently. Rather, it has now been realized that it is simply adequate to note that, when the fuel cell is operating in a certain lower part of its spectrum, then it is, for these two peripherals, adequate to reduce the flow rate of coolant and also adequate to operate the hydrogen purging device at a lower rate.

In contrast, conventional schemes require some complex control scheme where the power output is continuously monitored and the level of operation of, say, the coolant pump or hydrogen purging device is continuously monitored or varied in some continuous manner, with the intent that it would track the power output to give some optimum performance. This is complex and costly in various ways. It has now been realized that, for such peripherals, such close tracking of the actual power output level gives little or no benefit in overall performance.

Crutially with respect to claim 1, it can be noted that while Figure 3 of Blum may indeed show variation of fuel supply with a target current, it is wholly silent on the issue of controlling a coolant pump or a hydrogen purging device. Accordingly, it is submitted that these claims are clearly novel within the meaning of 35 U.S.C. 102(e).

With respect to claims 2, 7, 12 and 16, the Examiner noted that Blum et al. control the fuel mass flow in response to the current demand of the system, so that, in this case, the fuel cell peripheral is the reactant supply line. The relevance of this to the amended claims is completely unclear. As noted, the peripheral recited in claim 1, at least one of "a coolant recirculation pump" and a "hydrogen purging device".

With respect to claims 4, 9 and 13, the Examiner noted that it is of particular interest that Blum et al. employ a relationship between the current demand and the fuel mass flow as a function of time. He therefore argued that Blum et al. readily envisaged using stored values as a fuel cell operating threshold.

Without for the moment conceding the validity of this argument, it is again noted that Figure 3 of Blum again, at best, shows the supply of fuel and air should closely track the current demand. One can note the discussion in paragraph 31 of Blum et al., which notes that the system should have a "dynamic response". It refers to representing the system by differential equations and that the eigenvalues and eigenvectors of these equations determine the transient response of the system. All of this follow conventional control practice, and nowhere suggests that peripheral devices could be operated at discrete, constant and fixed levels, each level corresponding to part of the fuel cell operation characteristic spectrum.

Claims 1, 6, 11 and 15 stand rejected under 35 U.S.C. 102(b) as being anticipated by Harashima 5,290,641. The Examiner specifically referred to Figures 1 and 6 of this reference.

As noted previously, Harashima appears to be concerned with the handling of transients in a fuel cell system. One can note the statement in Harashima at column 7, lines 4 and 5 that "the reference flow rates Q2 and Q2' are reformed gas in the reactant air, respectively are calculated on the basis of the reference current value 12 and typical IV curves of the fuel cell". Thus, like the rest of this art, this reference merely teaches that flow rates for these reactant gases should be controlled as a direct function of the reference current value in this case. This is entirely to be expected.

Again, control of reactant gases is not control of a peripheral, but rather control of the basic reactants necessary for operation of a fuel cell. To repeat, it is understandable and largely necessary that these be controlled so as to closely follow the power demand, however this is measured. There is no teaching or suggestion that any peripheral can be operated at discrete and constant levels, over a range of values within a fuel cell operation characteristic spectrum. Again, Harashima is wholly silent on the issue of how the fuel cell peripherals of a coolant pump and a hydrogen purge valve can be controlled or operated.

Claim 1-2, 4-7 and 9-16 stand rejected under 35 U.S.C. 102(e) as being anticipated by Ueda et al. 2005/0136311.

The Examiner argues that this reference discloses a power generation control system including various elements necessary for operation, such as "load

detection means for detecting the power requested by a load; an output control means, etc."

What is striking about Ueda et al. is that while it may indeed disclose some sort of control means for controlling a hydrogen supply means 2 and an air supply means 3 (as shown in Figure 1), it is silent in the issue of controlling peripherals as now claimed, namely a coolant recirculation pump and a hydrogen purge device. It is again argued that this reference fails to disclose the invention as now claimed and thus the rejection under 35 U.S.C. 102(e) based on Ueda et al. should be withdrawn.

With respect to claims 2, 7, 12 and 16, the Examiner argued that Ueda et al. show with sufficient specificity to control the flow rate of reactant in response to output power requirements. Again, the relevance of this argument to these claims is not clear. While claim 2 may specify that the fuel cell operation characteristic is selected from the group consisting of current, current density and power output, the question is not whether Ueda et al. teach control of the flow rate of the reactant, but rather whether Ueda et al. teach control of a fuel cell peripheral as defined in claim 1 and elsewhere.

With respect to claims 4, 9 and 13, it is submitted that these claims are allowable both for introducing further patentable features and for being dependent from an allowable independent claim.

Similar comments apply to claims 5, 10 and 14.

Examiner's Response to Applicant's Earlier Arguments

The Examiner noted that the amendments to the claims included the new limitation "*to provide a respective, different and constant operational characteristic...*" but argued that this added "very little to the patentability of the claims because it is believed that the prior art of record meets this limitation". It is submitted that the Examiner's arguments in this respect are wholly unsupported. The Examiner went on to note that: "The prior art of record has been characterized by the Examiner as necessarily encompassing...". It is submitted that the issue is not how the prior art is characterized by the Examiner, but rather exactly what features are or are not disclosed in the prior art.

More specifically, the Examiner argued that any fuel cell system necessarily exhibits different modes of operation and identified modes of (a) a first operating mode being the standard operating mode for power generation; (b) a second operating mode being when the fuel cell is shut down; and (c) a third operating mode that may be a fuel cell starter mode. These labels and operating modes are purely arbitrary and have been assigned by the Examiner.

Fuel cells, like a wide variety of other types of machines, equipment, etc., have operating characteristics that can be described or defined in different ways. Thus, a fuel cell necessarily has an output, and in general terms, this output can and will vary from zero to some maximum level. On this basis, one can then determine that there is some spectrum or range of operating values between the zero and maximum operating levels.

In the present case, the Examiner has taken this continuous range of operating levels, and assigned some significance to 3 arbitrarily selected operating modes. Having then assigned these arbitrary modes, the Examiner argues that the prior art must then have different ranges. It is submitted that none of this detail is found in the prior art, and is arrived at simply by taking features of the present invention and using hindsight to assign them to the prior art references.

There are a number of distinct differences between the present invention and the prior art, namely:

(1) The prior art generally teaches treating any operational characteristic as a continuous spectrum;

(2) Having established that, for example, the power output is to be treated as a continuous spectrum, in accordance with standard control theory, some characteristic, e.g. supply of a reactant is controlled, e.g. in a proportional manner, so that it follows the power output level; this necessarily means that, e.g. the supply of the reactant would have its own continuous spectrum or characteristic corresponding to that of the fuel cell power output;

(3) All of this teaching is solely in relation to supply of reactants and the like, and not in relation to control of a peripheral device.

In contrast, what the present invention teaches is that there is no need for peripheral devices, here defined as a coolant recirculation pump or a hydrogen purge valve, to be controlled so as to have some continuous spectrum or characteristic that corresponds to a power output characteristic of a fuel cell. Rather, what has been realized is that for such peripheral devices, it is sufficient if they have a number of discrete operating levels corresponding to different ranges in a fuel cell characteristic spectrum.

It is possible that the ranges envisaged by the present invention may include one or more of the purely arbitrary modes of operation identified by the Examiner, e.g. a shutdown mode, but again there is no teaching in the prior art that (i) a peripheral should be controlled to have (ii) a constant level of operation assigned to a particular operating range of the fuel cell, and further (iii) a different and constant operational characteristic for each range.

The Examiner emphasized that Blum et al. "employ a relationship between the current demand and the fuel cell mass flow as a function of time to control and operate a fuel cell system" (Blum et al. at paragraph 0045-0046/Figure 3). Again, these paragraphs, if anything, teach away from the present invention. Note the reference in paragraph 0046 at lines 6 and 7 to the use of a "proportional control with a derivative action", a clear indication that Blum et al. are teaching that control of the reactants should closely follow and in some way be proportional to the power demand. This is exactly the type of control characteristic that the present invention is intended to avoid. Indeed, the Examiner appears to acknowledge that Blum et al. are teaching that the "flow rate of the hydrogen supply by the hydrogen supply means...and the flow rate of the air by air supply means 33 such that the flow rates can be optimum values". The present invention realizes that, for peripheral devices, there is no necessity to have an "optimum" level of operation, and it is sufficient to operate them at discrete and constant levels.

In paragraph 10 of the Action, the Examiner argued that Applicant's earlier arguments attempted to import into the claims language and features not actually present in the claims. The passage quoted (from Applicant's earlier argument) by the Examiner was merely attempting to provide an example of what the claim covered. It is maintained that the claims are clear, and to quote the actual claim language, claim 1 provides that "each fuel cell operation characteristic spectrum is divided into at least two ranges indicative of at least two corresponding ranges of power output". The previous arguments had merely given some exemplary interpretations of this feature and were not in any sense intended to be limiting.

In response to Applicant's earlier argument that "none of the prior art is concerned with operating fuel cell peripherals", rather than citing a reference to rebut this argument, the Examiner simply argues that, although the inventive concepts of the prior art are not centered on specific fuel cell peripheral, there is an inherent degree of controlling the operation of fuel cell peripherals. The Examiner went on to argue that, for many systems, there must be some degree of cooperation in the operation of the peripherals, e.g. if an entire fuel cell or engine system is shut down, then peripherals are necessarily shut down.

What this fails to recognize is that none of the prior art teaches a simple and efficient control scheme for the peripherals of a fuel cell. All the art cited by the Examiner is concerned, not with peripherals, but with more fundamental characteristics of a fuel cell, e.g. supply of reactants. If there is any "inherent degree of controlling the operation of fuel cell peripherals", the only teaching available in the art is that it would be effected similarly to control the reactants, etc., e.g. in a fully proportional manner. The present invention teaches directly away from this, as detailed above.

With respect to Blum et al., the Examiner conceded that this reference disclosed "no concept of recirculation", but strenuously contended that having an anode outlet or anode exhaust is a conventional structure. While providing an anode outlet or exhaust may be conventional, it is not always necessary. It is known to have fuel cells operated in a "dead-ended" manner, which has its own advantages and disadvantages. One cannot therefore necessarily treat an anode outlet or exhaust as being inherent or

implicit in the Blum et al. disclosure. Even if this is assumed to be present in Blum et al., it is submitted that the claims are still patentable over this reference.

In response to various points made by the Applicant in the earlier Response that the prior art was silent on details of fuel cell peripherals, adjusting operating levels of peripherals to reduce parasitic loads and the fact that the peripherals are not devices concerned with supply of reactants, etc., the Examiner replied in paragraph 13 of the Action. The Examiner argued that Applicant relied on the subject matter of definitions or meanings not currently claimed in the present claims and referred to "see item 14 above for more information", and also that Applicant overlooked the fact that the present claims failed to concretely define "fuel cell operation characteristic spectrum" in a more clearly defined manner. Firstly, the reference to "item 14 above" is not understood. Was the Examiner intending to refer to item or paragraph 14 below? In any event, it is submitted that the definitions in the claims are quite clear. The claims call for the presence of peripherals, comprising at least one of a "coolant recirculation pump" and a "hydrogen purging device". It is submitted that these definitions are wholly clear. Further, it is submitted that the definition of the "fuel cell operation characteristic spectrum" in the claim is again wholly definite and clear. It is defined as having at least two ranges indicative of corresponding ranges of power output.

The Examiner then reiterated the analysis that any such spectrum can be analyzed into different operating modes. Again, this language and type of analysis is taken from the present invention. It is not found in the prior art. In any event, the prior art is silent on dividing up any spectrum into a series of ranges, and then using these ranges to determine constant, discrete operating levels for peripherals of the fuel cell. The Examiner's whole analysis at the end of paragraph 13 is largely a regurgitation of language from the present application and is not found in the prior art.

With respect to Blum et al., in paragraph 14, the Examiner remarkably emphasized that Blum et al. mentioned the employment of "proportional controls". Applicant agrees with this statement. The present invention is intended to avoid the use of proportional controllers. It is not seen how this references advances the Examiner's arguments. This merely reinforces Applicant's argument that Blum et al., like the rest of

the art, teaches that control of fuel cell parameters should somehow be continuous or proportional and in dependence upon, for example, the power output. In contrast, the present invention does not teach proportional control, but rather the provision of individual and discrete operating levels for fuel cell peripherals.

With respect to Harashima '641, the Examiner argued that since the rejection was made under section 102, the issue of whether it teaches away from the present invention or fails to solve a problem identified by the present invention are not germane to a novelty rejection under section 102. Harashima fails as a proper reference under section 102 for a variety of reasons, and it is simply here noted that it fails to disclose a coolant recirculation pump or a hydrogen purging device.

In reply to Applicant's earlier arguments with respect to Harashima, e.g. the issue that Harashima does not teach controlling peripherals that are independent of the load requirement, the Examiner argued that limitations from the specification cannot be read into the claims. It is submitted that the peripherals now recited in the claims, the recirculation pump and the hydrogen purge valve are clearly peripherals that are "independent of the load requirement".

In paragraph 17, dealing with Ueda '311, the Examiner submitted that Applicant's arguments were not understood because "Applicant's claims recite that a hydrogen recirculation pump and a hydrogen purging means can be one of the fuel cell peripherals." As the claims have been revised to delete reference to the hydrogen recirculation pump as one of the peripherals and to retain reference to the "coolant recirculation pump", it is submitted that this argument is no longer applicable. Additionally, the hydrogen purging means is not concerned with supply of hydrogen as a reactant.

With respect to claims 2-3 and 7-8, the Examiner argued that the cited references do encompass "hydrogen and purging means". If they do disclose control of hydrogen purging means in the manner taught by the present invention, the Examiner is requested to cite appropriate passages.

Finally, it is submitted that the amendments and arguments are now fully in compliance with 37 C.F.R. 1.111(b).

Accordingly, early review and allowance of the claims is requested.

Respectfully submitted,

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